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DECIDUOUS FOREST MAN AND THE GRASSLAND FAUNA[1]

By Professor V. E. SHELFORD

UNIVERSITY OF ILLINOIS

I. INTRODUCTION

THE droughts and dust storms of recent years have called attention to the grasslands of central United States and Canada. Much has been written regarding the Great Plains on the subjects of (a) too extensive use of the plow, (b) overgrazing, (c) erosion. Remedies have been suggested, such as seeding with foreign and domestic grasses, special agricultural methods and the planting of shelter belts. There remains one factor in the disasters of the great plains that has not been evaluated or even adequately brought to attention, that is the sum total of original native animals of the grassland biotic community.

The grassland originally presented a fine array of grasses tall and luxuriant at the eastern edge and relatively short and hardy at the western. It originally presented an excellent group of animals living in a state of dynamic balance. But to the new human arrivals, the immense herds of bison merely meant free meat and free hides. As to the use of grassland animals by fur and hide seekers, noteworthy records are in the journals of Lewis and Clark (1804–05, Thwaites)[2] and of John C. Luttig (1812–13).[3] Lewis and Clark crossed the entire grassland area. The first grassland animals, notably the bison, were seen in southeastern South Dakota. The bison fitted the climate and grassland so well that its population (total, 75,000,000; Great Plains, 50,000,000) exceeded the

[1] Invitation paper read by title before the eighth American Scientific Congress, Section of History and Geography.

[2] R. G. Thwaites, "The Original Journals of the Lewis and Clark Expedition, 1804–1806." Vols. 1–3. New York, 1905.

[3] J. C. Luttig, "Journal of a Fur-trading Expedition of the Upper Missouri, 1812–13." Edited by Stella M. Druman. Missouri Hist. Soc., St. Louis. 1920.

present human population on the same area. The antelope was also an important game animal with a total population estimated at 30,000,000, 8,000,000 of them on the Great Plains. Associated with the spectacular ungulates were the well-known wolf, coyote, kit fox, badger, numerous well-known rodents such as the prairie dog and thirteen lined ground squirrels and a full quota of smaller rodents and small predators.

During the early cattle days, trapping was an important vocation on the plains. Colonel Richard Irving Dodge[4] says:

> When I first came to the "Far West," thirty-two years ago, trapping was still an institution (about 1850). Generally alone, sometimes in couples, rarely in more numerous companies, trappers ranged the whole country wherever peltries were to be had. . . . Each, making his way to the village of Indians most convenient to the territory in which he wished to trap, proceeded to interview the chief, whose friendship and protection were gained by generous presents. . . . Other presents purchased one or more squaws and a teepee. He thus became a member of the tribe.

The principal rough hides from the grassland were bison, antelope, wolf and coyote. Since the bison hides constituted a large part of those traded, there was a sharp decline in the fur business with the extirpation of this animal which came about in large areas soon after 1870. Most of the furs were from the water courses, and to what extent such species as the kit fox, spotted skunk and black-footed ferret were utilized is not clear, though Woodhouse[5] mentions foxes in connection with the southern plains. Lewis and Clark mention trade in kit fox skins in eastern Montana.

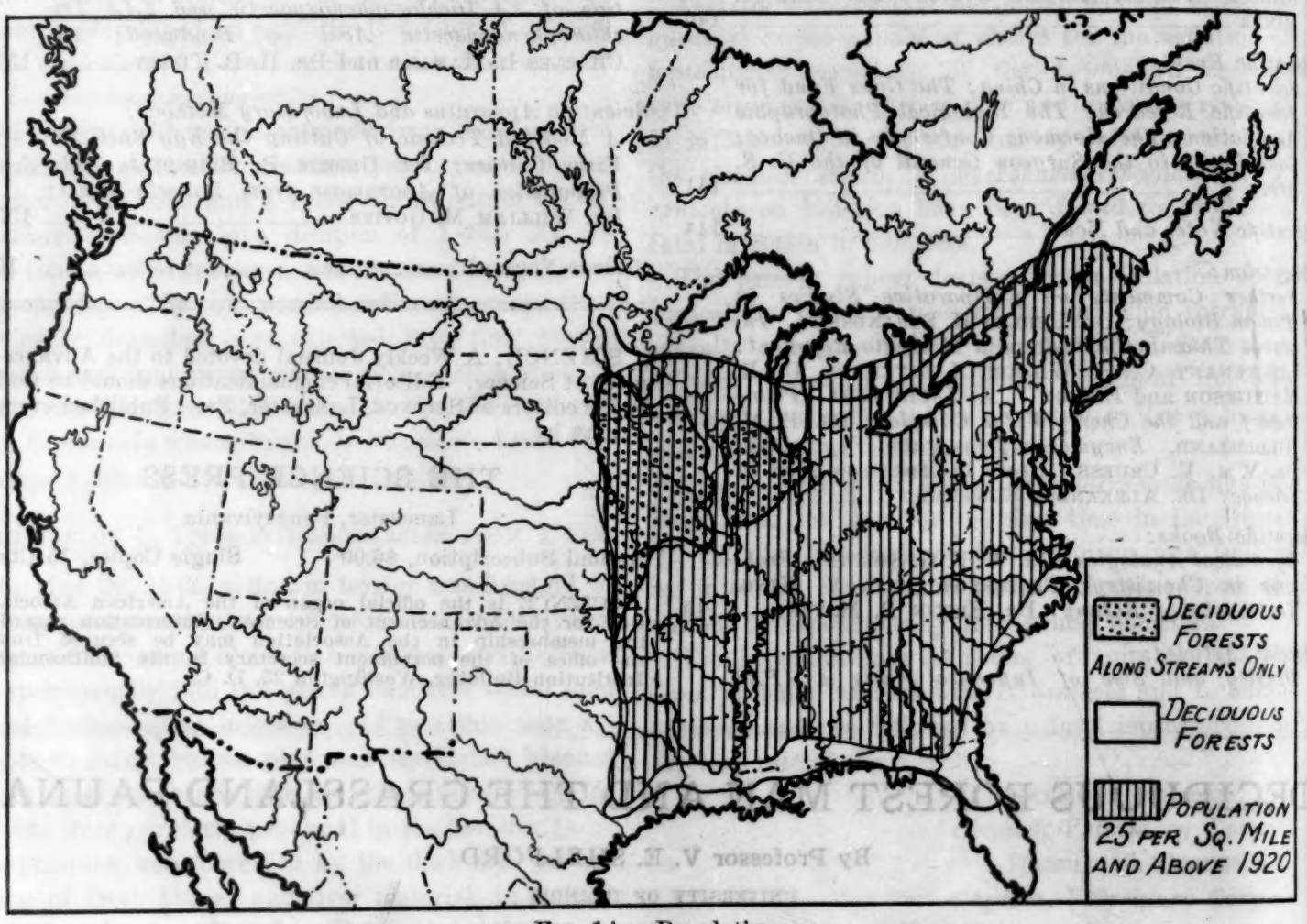

FIG. 1A. Population

Both maps show the concentration of the white man's activities in the deciduous forest areas. (See opposite page or B. Energy and health).

While the treatment of the grasses by the white man is notoriously bad, the consideration and management for the animals was in general far less intelligent than for the grass itself. The cow perhaps necessarily replaced the bison and antelope. No one could be expected to tolerate the wolf, but while these were being destroyed and after they were gone, an entirely unscientific attack on the remaining animals has continued unrelentingly.

The main objective of this discussion is to point out the interactions of the four elements involved in ex-

[4] Richard I. Dodge, "Our Wild Indians." Hartford. 1883.

[5] S. W. Woodhouse, Report on the natural history of the country passed over by the exploring expedition under the command of Brev. Capt. L. Sitgreaves. Mammals. In Sitgreaves' report of an expedition down the Zuni and Colorado Rivers. 198. Washington, D. C. (U. S. Cong. 33, First Session. Senate Ex. Doc.) 1854.

ploitation of the North American grasslands; the biotic community animals, the plants, the habitat and the settlers. This involves a discussion of each of the following:

(1) The original character of the native animals and their interactions or coactions with each other and with the plants.

(2) The general character of the plains habitat and its plant community.

(3) Certain physiological and psychological characteristics of the white settlers, together with their customs, cultural background and industrial prejudices.

It seems best in a review of the history of the great plains grassland to take up the qualities of the settlers in general, followed by a discussion of the trapper, trader, cattle man and plow farmer.

II. The Settlers, Their Origin, Character and Industrial Prejudices

The civilization of western Europe, source of the settlers on the plains, was developed chiefly in deciduous forest areas. Descriptions of Europe about 1400, however, state that there were partial clearings around the greater centers of population, that is, adjacent to such cities as Paris, Vienna and London, but great stretches of unmodified forest remained. Soon after this settlers began coming to the shores of what is now the United States from the oak and beech forests of the other side of the Atlantic. The most successful were those who landed in deciduous forest similar to that of Europe.

(1) *Physiological and Psychological Characteristics:* In general, the preference for forests on the part of the white man of western Europe is based both on his psychological and physiological qualities. Physiologically, he is not well adapted to long periods of exposure, either to the full heat of summer or to the cold of winter. He is not comfortable without shade in summer and in winter he is unable to cope with the climate without self-devised protection. To meet the physiological requirements of winter, he very early developed the art of building houses from forest materials. His difficulty with the cold was not wholly alleviated with the shelter; he found it necessary to have added warmth during extremely cold periods by the use of fire. This required fuel and the forest provided for this need, too.

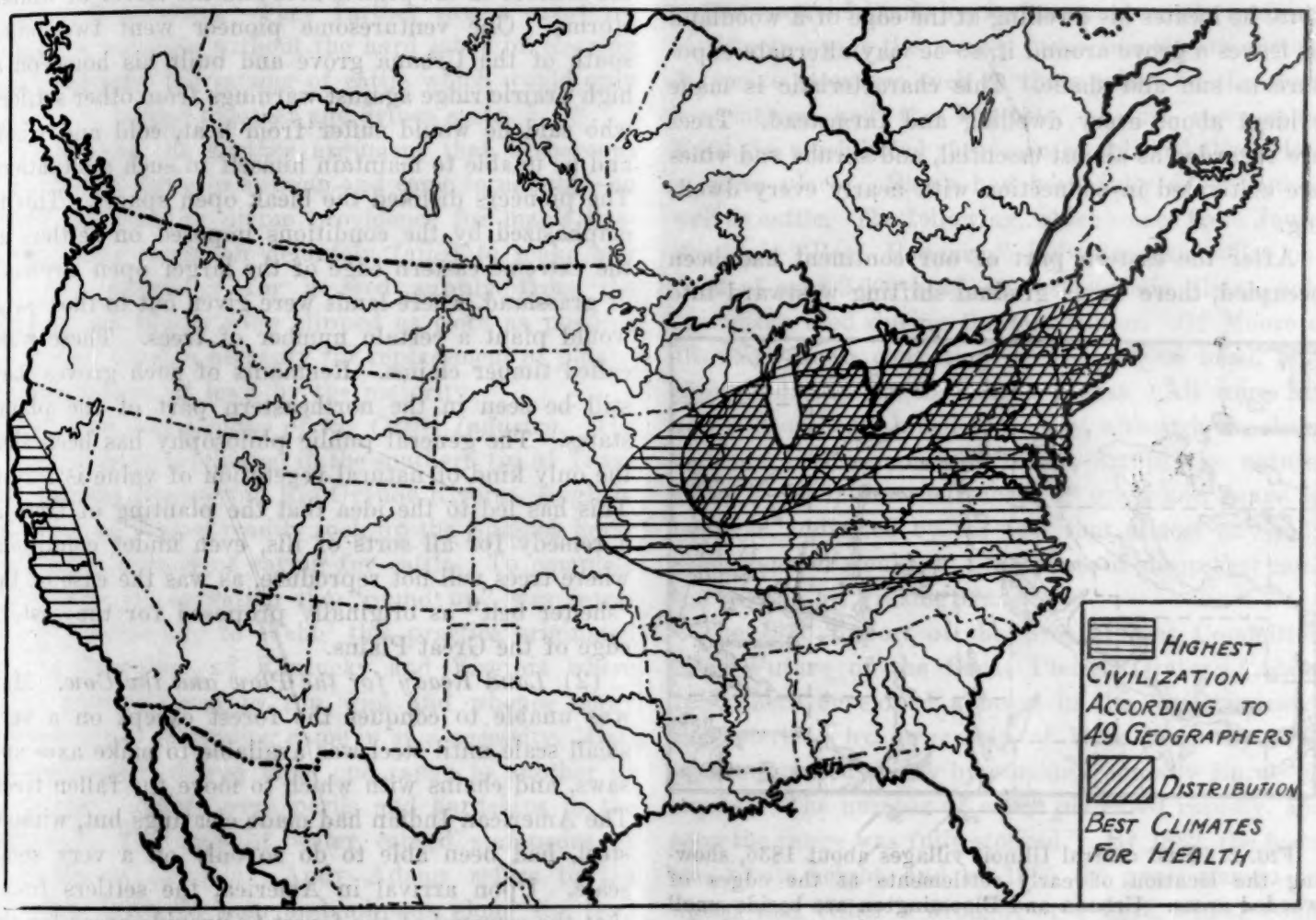

FIG. 1B. Energy and Health

These requisites against the extremes of summer and winter do not express all the white man's innate preference for forest conditions. He is, evidently, physiologically adapted to the deciduous forest climate as

regards population size and reproductive capacity. Huntington[6] has shown maps of the white man's energy in which the areas of highest vigor are largely in deciduous forest climate. Furthermore, since large populations of plants and animals occur in most favorable conditions, the same principle may be expected to apply to man. Figs. 1A and 1B show the locations of the *deciduous forest* of North America, dense population and high energy.

There is further evidence of man's preference for forest in the details of arrangements about his abode, since he locates his dwelling at the edge of a woodland or leaves a grove around it, so he may alternate exposure to sun and shade. This characteristic is made evident about every dwelling and farmstead. Trees are regarded as almost essential, and shrubs and vines are cultivated in connection with nearly every dwelling.

After the eastern part of our continent had been occupied, there was a gradual shifting westward into

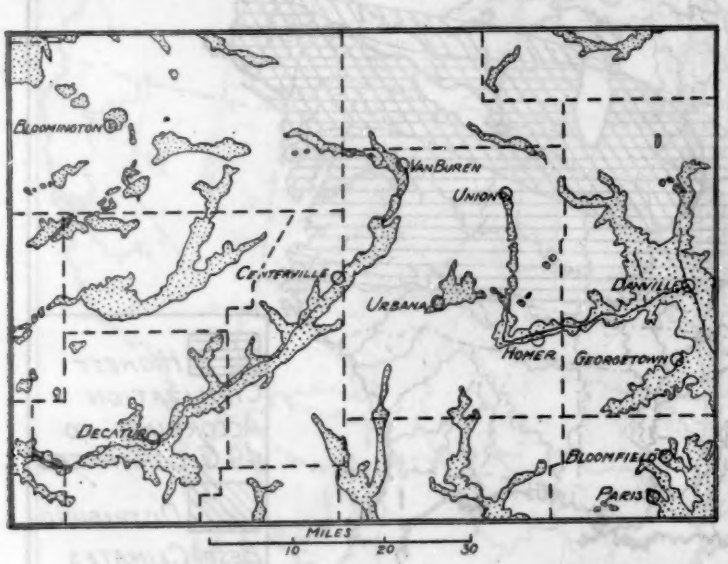

FIG. 2. East central Illinois villages about 1836, showing the location of early settlements at the edges of wooded areas. Urbana and Bloomington are beside small groves at some distance from streams large enough for the use of the canoe.

the parkland areas which were characterized by groves of trees and trees along streams. There were rather large stretches of prairie between them in Illinois, and still larger stretches in Iowa and eastern Nebraska. If one looks at the location of the early settlements, it appears that but two things were considered: (1) the possibility of canoe transportation and (2) the presence of timber. The second fact is brought out when one studies the location of the earliest settlements in central Illinois. In this parkland area, even though streams large enough for canoeing were not present, settlements were found near large groves. The Champaign County city of east central Illinois (Fig. 2), where this paper was written, had its beginning in a triangular grove of trees covering about fifteen square miles but not traversed by streams of sufficient size to be of much importance as a means of transportation. In this county most other early towns were located either near woodland, on streams, or in isolated groves.

In general, the early settler avoided the prairies; at first in part for the reason that he thought they were not fertile because they were treeless. As his experience increased, there were added to this reason the menace of the prairie fires and the terror of winter storms. One venturesome pioneer went two miles south of the Urbana grove and built his home on a high prairie ridge against warnings from other settlers who said he would suffer from heat, cold and wind, and be unable to maintain himself in such a situation. The pioneers disliked the bleak open spaces. This is emphasized by the conditions imposed on settlers at the extreme eastern edge of the larger open stretches of grassland, where lands were given out to those who would plant a certain number of trees. These were called timber claims. Remnants of such groves may still be seen in the northeastern part of the plains states. The general public philosophy has been that the only kind of natural vegetation of value is forest. This has led to the idea that the planting of trees is a remedy for all sorts of ills, even under conditions where trees will not reproduce, as was the case of the "shelter belt" as originally proposed for the eastern edge of the Great Plains.

(2) *Land Ready for the Plow and the Cow.* Man was unable to conquer the forest except on a very small scale until steel was available to make axes and saws, and chains with which to move the fallen trees. The American Indian had made clearings but, without steel, had been able to do so only on a very small scale. Upon arrival in America, the settlers found that the removal of the forest to provide areas for the growth of plants used as food and to provide concentrated forage for domesticated animals was a colossal task. This can hardly be realized by those who have not experienced it. It was only with titanic labors that the early settler, single-handed, cleared the land of timber. When all was ready, a "brush-burning bee" or "fallow burning" was organized, and most of the neighbors were present to assist. Then followed the first crop of wheat on the new land, cut, even in recent years, with a scythe or sickle. There was the continued fight against sprouts from still-living roots. The "grub axe" and "bush hook" were implements in regular use on a new clearing over a period of years. Sprouts had to be grubbed out and stumps had to be burned or pulled. It required eight or ten years to clear land completely. Blue grass had to be put out to produce verdant pastures, like

[6] Ellsworth Huntington, "Civilization and Climate." Third edition. New Haven. 1924.

those of western Europe, for livestock. Even then there was still the struggle against seedlings along fences and the spread sprouts into the meadows.

With a long experience of this kind as a background—one in which plants had to be combated and in which abundant rains kept grasses green and readily replaced, it is not strange that deciduous forest man should have erred in the grassland. With no knowledge whatever of the efficient set of checks and balances in a grassland fauna, those who entered the drier plains saw luxuriant grasses being cropped by bison and antelope. They further saw a great resource, a vocation without the hard labor of clearing land—namely, the raising of cattle which would only have to be herded together and driven east.

There was the further argument that herbaceous growth died down in autumn and came to naught—no doubt intended by divine providence for man's livestock. The stockman definitely failed to make any adequate provision for a seed supply from the grasses; all plants were clipped as close as possible by cattle. Seed, a necessity for replacement of plants, was forgotten, at least by the majority.

(3) *Rise and Decline of the Cattle Industry.* The cattle industry originated in the southern tip of Texas between the Nueces and Rio Grande Rivers. English-speaking cattlemen readily took up the Spanish horse and lariat method of caring for cattle. To complete the system of operation the "round up" was introduced. According to Webb[7] this practice originated in the mountains of Kentucky and Virginia where cattle were allowed to run wild and whence many settlers came. Branding came in as a necessity. Cattle were often driven from one range to another or to market. There were perils and hardships in the "drives." The lack of water caused stampedes of thirst-crazed animals. Andy Adams refers to the bleached bones of men and animals along the trail (see Webb, page 266) resulting from stampedes and other perils. The "cowboys" of Austin's Anglo-American colony began driving cattle from their area in 1837.

The tall grasses of the eastern edge of the grassland withstood cropping better than those of the drier areas farther west, but to newcomers it made no difference. Stock raising on these ready-made pastures temporarily became one of the great industries of the west. There was no plowing, no rush of the harvest season and no dust of threshing. Books with such titles as that of Brisbin's[8] "Beef Bonanza; or, How to Get Rich on the Plains" indicates this state of mind. Many a trapper and adventurer turned his attention to this industry with knowledge of neither grasses nor animal husbandry. However, the cattle business grew rapidly during about forty years, and worked northward from Texas and westward from the Mississippi Valley. By 1870, the projected railroads and much general advertising had resulted in a large westward migration of farmers as well as cattlemen. Overgrazing doubtless began to be evident in some localities about this time. The wiser had tried to save the range through summer grazing in high altitude and winter grazing in low altitude.

The encroachment, by farmers and newly arriving cattlemen, upon the ranges came in spite of strong defensive measures such as those taken by the stock associations and the boycotts, against newcomers. Even the much-hated sheepmen established themselves in some places. Sheep had been fully advertised as well as cattle. The following, which comes from James Brisbin's "Beef Bonanza," indicates this: "In one flock of over 2,000 head, on the Laramie Plains, only two sheep died during the last winter. Of Moore & Brother's flock, consisting of over 10,000 head, only eight had died up to February first. All were fat, and mutton being killed every day, although the sheep had not had a mouthful to eat except the natural grass." Their destructiveness of grass and range is, however, indicated by the fact that almost any mild cattle rancher would cut the throats of sheep that came too near to his grazing lands.[9]

The 1936 Report of the Great Plains Committee, "The Future of the Great Plains," states: "About 1880 there developed a boom in the cattle industry characterized by ownership of large herds by companies financed chiefly by outside, generally European capital. The number of cattle increased rapidly, and soon the range was fully stocked." By 1882, the boom was at its height, and by 1885 the grass was so reduced that either a drought or a hard winter could bring disaster. Disaster did come, first in the form of a severe winter, and then in the form of drought. The winter of 1886–87 was unusually severe, and large numbers of cattle perished. Bad winters and prolonged drought (1886–93) terminated the large cattle "outfits" on the open range. The overgrazing accompanying the boom was followed by a severe grasshopper outbreak felt in the lower Missouri Valley.

Overgrazing destroyed the original character of much of the eastern portion of the grassland area and has continued and extended westward.[10] In areas where shrubs, cacti, etc., occur on rough rocky ground and unfavorable soil, in scattered spots over the grassland, these coarse plants spread into the over-

[7] W. P. Webb, "The Great Plains." Ginn and Company. 1931.

[8] James S. Brisbin, "The Beef Bonanza; or, How to Get Rich on the Plains." Philadelphia. 1880.

[9] H. C. Hanson, *Scientific Monthly*, 46: 230–241. 1939.

[10] J. E. Weaver, *Am. Jour. Bot.*, 12: 502–509, 1925.

grazed area and further reduce the water available for the already reduced and cropped grasses and other forage plants. Sage-brush, rabbit-brush, prickly pear (Opuntia) and other cacti are important. Sage-brush is especially important in this respect in northern regions: overgrazing is responsible for much of the so-called sage-brush desert. In southern regions cacti such as staghorn opuntias and shrubs as Larrea, Franseria and various other coarse plants play an important role and favor the invasion of the larger rodents which intensify unpalatable plant invasion. Moderately grazed grasses are able, however, to steal the water from the invaders and kill them out again.

The increase in rodents which results from the destruction of their enemies hastens the depletion of grasses because some rodents use the grasses just as the cattle do. Some rodents are favored by overgrazing; grasshoppers are also favored and may take further toll from the depleted grasses.

In addition to invasions by coarse plants, small trees have behaved similarly and had similar effects. For example, the cattle business of the United States had its beginning in the gulf coast tallgrass prairie. This is an area almost universally mapped as mesquite—chaparral or savannah and regarded by many as having been that type before the white man came to the area. On the contrary, since cattle eat the mesquite beans and fail to digest them, they spread the seed widely and may be responsible for the entire savannah. It is well known that the mesquite has been spread from south central Texas into west central Oklahoma by this method. The effect of the mesquite trees ranges from a slight depreciation of the grazing value of an area, to almost complete elimination of the grasses.

(4) *The Development of Crop Farming.* Cattle ranching and farming within enclosures made possible by the invention of barbed wire replaced the cattle outfits. This step was aided by the introduction of the wind mill to pump stock water from wells. The transition was nearly completed by 1895. In general, homesteaders contributed to the difficulties of the cattlemen. Covered wagons swarmed over the land, land prices rose, and the ranchman cut up another pasture which he turned over to the farmers, mostly on credit.

As homesteaders increased, the plow turned more and more land wrong side up each year. Sometimes crops were good, and sometimes poor or indifferent. Webb described their plight as follows:

> A few wet years, and the farmers all make bountiful crops of wheat, forage, and even of corn. They wrote "back East" to tell their brothers and sisters and friends about it. Finest land in the world! Plenty of rain; no "grubs" to dig out of the soil. Land to be had for one-fifth of what they ask for that worn-out land in the East. Good health, no chills, no fever, no doctor's bills. And, besides, the country is "getting more seasonable." Always that fiction, the expression of a vain hope, asserted itself in the fat years of the West. Then came the drought, and the covered wagons stole away, taking their occupants back East to the cotton patches and cornfields or shops of their former neighbors, there to become tenants or wage-earners, their spirits crushed, fortunes gone.

While on the plains, each of these settlers also plowed some land, killed some predator enemies of rodents and left the plains in a worse condition than when he arrived.

(To be concluded)

OBITUARY

IN MEMORY OF CHARLES E. SANBORN

In the passing on July 5, 1944, of Charles Emerson Sanborn, formerly professor of entomology and head of the department of entomology, Oklahoma Agricultural and Mechanical College, the State of Oklahoma and the nation has lost a highly esteemed citizen and scientist.

Ten years of intimate personal association with Professor Sanborn on our anaplasmosis project was a rare privilege. The many field trips, laboratory contacts, conferences and experimental procedures brought to light the true character of the man. He was a loyal and true friend. His interests in human endeavor were legion. Many a young lad received a deeper individual insight into the realm of natural agencies through him, and he contributed much to the Boy Scouts along these lines.

Professor Sanborn was an untiring worker and a keen observer in the field of applied science. Well do I recall his observations on the mating instincts of the horse-fly (*Tabanus sulcifrons*) during the early hours one summer morning at Girard, Kansas. He was awakened just at the brink of dawn by an incessant buzzing sound, and my attention was called to the air being literally alive with huge swarms of these insects. Within a short period, when the sun began to shine, but few of the flies were to be seen.

On other occasions his keenness of observation were noted in calling my attention to swarms of flying ants on the distant horizon. Only a trained observer would discern such phenomena.

In our quest for the collection of ticks, many hours and nights were spent in looking for new species or particular kinds of ticks for experimental use in the

anaplasmosis project. One of the last cases I now recall was when the hounds treed a large coon about midnight in northeastern Oklahoma. Two balls of fire shone from the top of a great oak tree. A timely shot brought "Mr. Coon" to earth. From around its ears and head we recovered several specimens of much desired castor-bean ticks, *Ixodes scapularis*. During our period of field activity, 16 species of ticks were collected in Oklahoma. Some of these were unknown species for the state, *e.g., Ixodes Kingii* and *Ixodes Texanus*.

One result of the anaplasmosis project was the establishment of a splendid tick collection, perhaps the most extensive in the southwestern United States, now available at the Entomology Department of the A. and M. College, Stillwater, Oklahoma.

Largely through the efforts of Professor Sanborn, cooperating with Dr. E. E. Harnden, Dr. Harry W. Orr, Dr. Lewis H. Moe and myself, the transmission of anaplasmosis by horse-flies was established, since confirmed by other scientists. He was joint author of several published articles on the subject of this disease in cattle. I shall miss his kindly smile and native wit.

GEORGE W. STILES

DENVER, COLO.

WILLIAM HARMON NORTON
1856–1944

AMERICAN geologists join with widow and friends to mourn the passing of a great scientist, teacher, scholar and author, William Harmon Norton, who died at his Mount Vernon, Iowa, home on May 3, 1944.

Dr. Norton enjoyed a long and distinguished career which brought honor to him and the institution he served so faithfully for sixty-nine years. He was a tireless and meticulous worker, keenly interested in current events as well as his chosen field right up to the time of his death. To few men is given the keenness of mind that was his. As one biographer has stated, "He would have been great in any field."

Dr. Norton was graduated from Cornell College, Iowa, in 1875 and became tutor in Latin and Greek. Two years later, 1877, he became adjunct professor of Latin and Greek, a post he held until 1881. He received the Master of Arts degree in 1877. In the meantime he became interested in the science of geology and in characteristic thorough fashion probed its depths and later became one of the outstanding names in the science. In 1881 he became professor of Greek language and literature and geology and in 1890 abandoned the teaching of Greek and became professor of geology. The latter chair he filled until 1924, when he became professor emeritus. However, Norton continued to teach one class in evolution, a field which had challenged his mind, until 1942. Until his death Professor Norton continued to write in the field of evolution, publishing both in the United States and abroad.

In the course of his long career he received many honors. The State University of Iowa bestowed upon him the honorary degree of Doctor of Laws in 1911. He was a member of Sigma XI and Phi Beta Kappa, a fellow in the Geological Society of America, president of the Iowa Academy of Science in 1900. Dr. Norton was assistant on the U. S. Geological Survey from 1903 to 1913. His keen business judgment and other qualities caused him to be elected to the board of trustees of Cornell College in 1924, a post he held for twenty years, at which time he became an honorary member.

Dr. Norton attained world-wide recognition for his ground-water studies in Iowa; however, it was as a teacher that he liked best to be known. In this field he gained the love, respect and admiration of a host of students, many of them later to become famous in their own right. He was the author of "Elements of Geology," a text widely used in schools and colleges.

Dr. Norton's interests were many. He accumulated a vast library of fine music recordings and, as was his custom, delved deeply into music history. He often stated, "Jazz is an abomination to my ears." His tulip garden, embracing many hundreds of choice bulbs, many of them species developed by himself, was a show-place of eastern Iowa. It was here that he loved to visit with his friends and strangers who came to view their beauty.

Professor Norton is survived by his widow, Mary Burr Norton, for many years on the mathematics faculty of Cornell College.

The great scientist is gone, but the earth and its history is the richer for his having been here.

NEIL A. MINER

CORNELL COLLEGE

SCIENTIFIC EVENTS

SCIENTIFIC CONDITIONS IN CHINA

DR. WM. H. ADOLPH, acting professor of biochemistry and nutrition at Cornell University, who has been professor of biochemistry at Yenching University, Peiping, China, has received a letter from Dr. P. S. Tang, physiologist at Kunming, from which the following excerpts are given:

We have been cut off from the external world since 1941. No new journals or magazines have reached us since that time, except the excellent microfilms which the

allied scientific missions are sending us, but they are few and far-scattered, and after all microfilms are microfilms. We should be interested in any biochemical and physiological publications you can send, that is if you can arrange the necessary transportation. May I suggest working through the British Central Scientific Office and the U. S. Scientific Office, both of these in Chungking and in Washington.

I am sending you through them the only complete set of our little *Biochemical Bulletin*. Please try to reprint them and send copies back. I am also sending manuscript research material and data on our laboratory work. We started from four walls here six years ago, with a small amount of equipment purchased in Hongkong. We have used home-made materials and have added to our stock from local drug stores; by now ours is a sizable and respectable laboratory—the Laboratory of General Physiology in the Institute of Agricultural Research of Tsing Hua University.

I am continuing work on cellular respiration. We have studied silk secretion from the silkworm, for which we were awarded the Ting Prize in 1942. We have obtained tetraploid barley which has been maintained up to the 4th and 5th generations. We are also working on war dietaries and have helped frame a national program for nutritional research. In plant physiology we are interested in the application of auxins to rooting and growth in general, especially vernalization. We are studying the utilization of products from tung oil and tung oil cake, and the whole question of farm wastes, also weed control. We are also growing yeast as meat substitute. We have found some interesting Chinese cultures, native material, which has been in use in China for centuries. It is strange how scientists are only now "discovering" these century old practices of the wise China! . . .

We lack everything in our laboratory, except morale and stamina. Work is going fine and we are keeping up high academic ideals and aspirations, which is difficult considering the rising tide of nationalism and the cost of living. Our university group is in dire poverty and many are half-starved. We need colorimeters, polarimeters, pH meters, chemicals of all sort, and especially mimeograph stencils for the *Biochemical Bulletin*. We urgently need chemicals and apparatus for amino acid analysis.

I am rather perplexed by the nice words and gestures of many in America about help to China; the most needy group, scientific workers, are getting nothing worth mentioning! Why not divert part of UCR donations, from which we get nothing, to professional men in China for the specific purpose of keeping body and soul together (myself excepted, as still comparatively better off). I have repeatedly requested funds to keep up our work, but no one seems to care a particle about our real needs. Our supplies of chemicals can last us only another year, and we must be extremely careful with apparatus and use gingerly each drop of HCl, let alone more expensive reagents. Many of our friends seem to think we can last forever. No one perhaps realizes the real plight that we are in; we are much worse off than the German scientists in 1918! Don't please just send gifts "to China," which means we never get any of them. . . .

THE GANS FUND FOR SCIENTIFIC RESEARCH

PRESIDENT W. H. CRAMBLET, of Bethany College, announces that the Gans Fund for Scientific Research now amounts to $50,000. The income from this fund, established by Wickliffe Campbell Gans and his brother in memory of their father and mother, is to be awarded for scholarships by Bethany College under such terms and conditions as the college and its faculty may prescribe, provided that one third of the annual income be made available to juniors and seniors "of merit and promise in some field of science" in residence in Bethany College; two thirds to be awarded to graduates of Bethany College to assist in scientific research.

At the present time the accumulated income, which amounts to $2,500, will be distributed to those who are interested in the fields of the natural and physical sciences. The following committee has been appointed to administer the fund:

Dr. B. R. Weimer, dean of the faculty, professor and head of the department of biology, *Chairman*.
Dr. J. S. V. Allen, professor and head of the department of mathematics and physics.
Dr. George E. Bennett, associate professor and acting head of the department of chemistry.
Dr. Florence M. Hoagland, academic adviser for women, professor and head of the department of English.
Dr. W. K. Woolery, provost of the college, professor and head of the department of history.

This gift to Bethany College has been selected for honorable mention in connection with the latest edition of "Who's Who in America" in its Third Biennial Citation for Exceptional Educational Philanthropy.

THE BIOLOGICAL PHOTOGRAPHIC ASSOCIATION

THE Biological Photographic Association will hold its fourteenth annual meeting on September 7, 8 and 9 in Binghamton, N. Y. Papers will be presented by experts in the fields of still and motion picture photography, photomicrography, etc. Round-table discussions will be held for the exchange of ideas and methods. A salon of pictures made by leading biological photographers from all over the country will be a feature of the meeting. Representatives from firms specializing in precision equipment will demonstrate their products.

The Ansco color process will be demonstrated in order that every one can see at first hand the simplicity of developing this new color material in his own darkroom. Also, a new color-printing method will be described which permits the making of color prints directly from color transparencies in one exposure step. Dr. Bruce Buckler, director of visual education of the International Business Machines Corporation, will present a paper concerning modern technique in

the preparation of visual aids. Special trips will be made through the Ansco plant.

Binghamton is conveniently situated on direct lines from Chicago, New York, Philadelphia, etc.; and its Erie and Delaware Lackawanna railroads connect with all other main roads. The Arlington Hotel will be convention headquarters. Reservations should be made well in advance.

The Biological Photographic Association is a non-profit organization for the study of photography as applied to medicine, dentistry and the biological and natural sciences. Its members are scientific photographers, scientists who use photography in their work and amateurs interested in biological and medical photography. The journal of the association is published quarterly, constituting a volume of about 250 pages, which is furnished free to members. Further information in regard to the association and the program of the convention may be obtained by writing to the Secretary of the Biological Photographic Association, University Office, Magee Hospital, Pittsburgh, Pa.

THE HORMONE CONFERENCE IN QUEBEC

THE Hormone Conference of the American Association for the Advancement of Science which met at Gibson Island last year has accepted the invitation of the Montreal Physiological Society to meet in Canada this year. The meeting will be held at Mont Tremblant Lodge, Mont Tremblant, Quebec, during the week of September 18. Mont Tremblant is in the Laurentian Mountains, about ninety miles from Montreal. The facilities of the lodge have been reserved exclusively for the members during the period of the conference. The program follows:

SEPTEMBER 18

Morning:

Reception of members at McGill University and inspection of laboratories in Montreal.

Noon:

Luncheon for members by the Montreal Physiological Society.

Afternoon:

Laboratory visits until 5:00 P.M.

Evening:

Travel to Mont Tremblant.

SEPTEMBER 19

Morning:

Section I. *Steroid hormones.*

Dr. Ralph Dorfman, Western Reserve University: "The Assay of Steroid Hormones."

Dr. Hans Selye, McGill University: "The Pharmacology of Steroid Hormones."

Evening:

Dr. R. D. H. Heard, McGill University: "The Metabolism of Steroid Hormones."

Dr. Konrad Dobriner, Memorial Hospital, New York: "The Excretion of Steroids by Normal and Pathological Subjects."

SEPTEMBER 20

Morning:

Dr. J. S. L. Browne, McGill University: "The Response of the Adrenal Cortex to Damage."

Dr. A. T. Kenyon, University of Chicago: "Factors in the Sexual and Somatic Development of Man."

Evening:

Section II. *Thyroid hormones.*

Dr. C. P. Leblond, McGill University: "Iodine Metabolism in the Thyroid Gland as Studied with the Help of Radio-iodine."

Dr. E. B. Astwood, Harvard University: "Antithyroid Compounds."

SEPTEMBER 21

Morning:

Section III. *Pituitary hormones.*

Dr. Robert W. Bates, The Difco Laboratories: "Physiology of Prolactin and Other Pituitary Hormones."

Dr. L. I. Pugsley, Canadian Laboratory of Hygiene: "Principles of Hormone Assay."

Evening:

Dr. R. L. Noble, McGill University: "Secondary Effects of Corticotrophins."

Dr. Abraham White and Dr. T. F. Dougherty, Yale University: "Influence of Hormones on Lymphoid Tissue Structure and Function."

SEPTEMBER 22

Morning:

Dr. C. H. Li and Dr. H. M. Evans, University of California: "Growth and Adrenocorticotrophic Hormones."

Section IV. *Experimental diabetes.*

Dr. F. W. D. Lukens, University of Pennsylvania: "Pituitary Diabetes."

Evening:

Dr. A. Simard, University of Montreal: "The Neuro-insular Complex of the Pancreas."

Dr. C. Duff, McGill University: "Islet Lesions in Human and Experimental Diabetes."

SEPTEMBER 23

Morning:

Dr. Charles H. Best, University of Toronto: "Factors Influencing the Insulin Content of the Pancreas."

Dr. George Gomori, University of Chicago: "Alloxan Diabetes."

Attendance at the conference is limited to a maximum of sixty members. Due to the special accommodations at Mont Tremblant and the prospect of a large attendance by Canadians a somewhat larger group will meet this year.

GREGORY PINCUS,
Chairman, Committee on Arrangements

CONSULTANTS TO THE SURGEON GENERAL OF THE U. S. ARMY

AMONG those recently appointed as consultants to the Surgeon General, U. S. Army, in matters pertaining to preventive medicine and public health are:

Dr. George K. Strode, director of the International Health Division of the Rockefeller Foundation.

Dr. C.-E. A. Winslow, Lauder professor of public health, School of Medicine of Yale University; editor, *Journal* of the American Public Health Association.

Dr. Hugh H. Smith, regional director for the United States, Canada and Mexico, International Health Division, the Rockefeller Foundation. For the past three years Dr. Smith has represented the Rockefeller Foundation in England where he has worked closely with the Ministry of Health.

Dr. Ernest L. Stebbins, commissioner of health, New York City; professor of epidemiology (on leave) De Lamar Institute of Public Health, Columbia University.

Dr. Abel Wolman, professor of sanitary engineering, the School of Hygiene and Public Health of the Johns Hopkins University; chairman of the Executive Board, American Public Health Association.

Dr. Claude E. Forkner, director of the China Medical Board. Dr. Forkner has recently returned from a year's assignment in China where he has been adviser to the Committee on Medical Education of the Ministry of Education. While in China he was also professor of medicine at the National Central University of the West China Union University at Chengtu.

SCIENTIFIC NOTES AND NEWS

THE American Section of the Society of Chemical Industry has awarded the Chemical Industry Medal to Colonel Bradley Dewey, in recognition of "his work in colloid chemistry, especially pertaining to rubber latex, and his accomplishment in administering the synthetic rubber program during a critical war period."

THE Sir William Schlich Forestry Medal has been awarded to Professor Henry S. Graves, dean emeritus of the School of Forestry of Yale University, "in recognition of distinguished services in his profession." The medal has been awarded to an American on two previous occasions. In 1935 it was given to President Roosevelt and in 1940 to Gifford Pinchot.

PROFESSOR GEORGE D. BIRKHOFF, Perkins professor of mathematics at Harvard University, has been elected a corresponding member of the National Academy of Sciences of Mexico.

THE following officers of the Chapter of the Society of the Sigma Xi of the University of Oregon have been elected for the academic year 1944–45: *President,* Dr. J. M. McGee, associate professor of chemistry; *Secretary,* Dr. L. E. Detling, assistant professor of botany; *Treasurer,* Dr. A. L. Soderwall, instructor in zoology. Dr. W. B. Youmans, associate professor of physiology, has been serving as vice-president of the chapter at the Medical School in Portland. The initiation of new members was held on May 13 and was followed by the annual joint banquet of the Phi Beta Kappa and Sigma Xi chapters. The twenty-first annual Phi Beta Kappa-Sigma Xi lecture was given by Dr. H. A. Spoehr, chairman of the Division of Plant Biology of the Carnegie Institution of Washington, D. C. His subject was "Some Responsibilities of Science."

THE retirement is announced of Dr. E. B. Hart, professor of agricultural chemistry at the University of Wisconsin and chemist at the Agricultural Experiment Station.

DR. JAMES A. BIZZELL, professor of soil technology in the department of agronomy of Cornell University, retired on July 1 with the title emeritus. He joined the faculty of the university in 1903 as an assistant chemist in the Agricultural Experiment Station. He is known for his work on the loss of plant nutrients in drainage water and on the influence of various crops on nitrate accumulation in soils.

DR. JULIUS HAYS HESS, of the College of Medicine of the University of Illinois, who has been a member of the faculty for thirty years, is retiring as professor of pediatrics and head of the department with the title emeritus. He will be succeeded by Dr. Henry George Poncher. Dr. Milan Vaclav Novak has been promoted to a professorship, and to be head of the department of bacteriology and public health.

PROFESSOR EDMUND M. SPIEKER has been named chairman of the department of geology of the Ohio State University, succeeding Professor J. Ernest Carman, who is relinquishing his administrative responsibilities to devote full time to teaching. Dr. Spieker has leave of absence until January 1 to work with the U. S. Geological Survey on a survey of strategic minerals in Alaska.

DR. T. C. DANIELS, professor of pharmaceutical chemistry, has been appointed dean of the College of Pharmacy at San Francisco of the University of California.

W. W. WILCOX, research professor of agricultural economics in the Iowa State College and Station, has

been appointed professor of agricultural economics at the University of Wisconsin.

DR. IVAN C. HALL, formerly professor and head of the department of bacteriology and public health of the School of Medicine at Denver of the University of Colorado, has been appointed professor and chairman of the department of bacteriology at the New York Medical College, Flower and Fifth Avenue Hospitals, succeeding Dr. Laura Florence, who will retire in September. Dr. Hall has been for the past two and a half years director of the Central Laboratory of the Contaminated Wound Project, Subcommittee on Surgical Infections of the National Research Council, with headquarters at the College of Physicians and Surgeons of Columbia University.

DR. THOMAS A. KEARNEY, of the Bureau of Plant Industry of the U. S. Department of Agriculture, has retired. He joined the staff of the department as assistant botanist in 1894.

JAMES A. HYSLOP, since 1934 principal entomologist of the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture, retired on August 1.

RICHARD B. PILCHER, registrar and secretary of the Royal Institute of Chemistry of Great Britain and Ireland, is retiring after serving for fifty-two years.

DR. REEVE M. BAILEY has resigned as assistant professor of zoology and as leader of the Iowa Fisheries Research Unit of Iowa State College, to become associate curator of fishes in charge of the Fish Division of the Museum of Zoology of the University of Michigan.

DR. CHARLES N. FREY, formerly director of the Fleischmann Laboratories, has been appointed director of scientific relations of Standard Brands Incorporated.

DR. FREDERICK F. YONKMAN, professor of pharmacology and head of the department at Wayne University, has been appointed chief pharmacologist at Ciba Pharmaceutical Products, Inc., Summit, N. J.

MAJOR GENERAL NORMAN T. KIRK, Surgeon General, U. S. Army, returned on July 21 from visits to the Italian and Normandy battle fronts, where he inspected during a twenty-day trip medical facilities, including those at battalion aid stations, as well as at Army hospitals in England.

COLONEL WILLIAM J. BLECKWENN, professor of neuropsychiatry at the University of Wisconsin, who has returned from a period of over two years' service in the South Pacific, has been appointed as the neuropsychiatric consultant to the Sixth Service Command with headquarters in Chicago.

PROFESSOR D. B. JOHNSTONE-WALLACE, agrostologist in the department of agronomy of Cornell University, returned to the United States on August 1 after a leave of absence of a year and a half granted for war work in Great Britain. While abroad he was deputy director and head of the agricultural department of the National Institute of Agricultural Engineering at Askham Bryan, near York. This institute is responsible for the testing of new agricultural machinery suitable for use in Great Britain. In addition to this work he made an extensive lecture tour through England, Scotland and Wales. He was also associated with the plant breeding stations at Aberystwyth and Corstorphine as well as with the Grassland Improvement Station near Stratford-on-Avon.

DR. A. C. MCFARLAN, professor of geology at the University of Kentucky and head of the department, is making a detailed study of the geology and mineral resources of the Salt Lick Quadrangle in eastern Kentucky, including the preparation of an areal geological map of the entire quadrangle. Attention will be given to the corniferous oil-bearing formations, as well as to the old Ragland oil field which is now being redrilled.

SIR HOWARD WALTER FLOREY, professor of pathology at the University of Oxford, who is largely responsible for the development of the use of penicillin, visited Washington during the first week in August. He consulted with certain officers in the Office of the Surgeon General and with members of the Committee on Medical Research.

THE Division of Physical and Inorganic Chemistry of the American Chemical Society, which will meet in New York City on September 11, has planned a symposium on fluorescence and luminescence. Dr. George S. Forbes, of Harvard University, has been appointed chairman of the symposium. The speakers will include Dr. Jacob Bigeleisen, of the War Research Division of Columbia University; Dr. Henry Eyring, of Princeton University; Dr. H. W. Leverenz, of the R. C. A. Laboratories at Princeton, and Dr. Peter Pringsheim, director of spectrographic research at the Ray Control Company of Pasadena, Calif., formerly of the University of Chicago.

THE Army Medical Department needs five hundred officers for assignment to the Sanitary Corps to fill vacancies and to relieve physicians and surgeons from professional duties. A survey of civilian and Army personnel is now being made to find qualified entomologists, sanitary engineers, bacteriologists, biochemists, parasitologists, nutritionists and industrial hygiene engineers. Officers in other branches of the service whose qualifications are not fully used in their present assignments will be considered for duty with

the Sanitary Corps. Requests should be forwarded to Adjutant General, U. S. Army. Civilians, warrant officers and enlisted men will be given direct appointments as officers in the Sanitary Corps. Applications should be made in writing to the Officer of the Procurement Service in the Headquarters of the Service Command in which they reside or to the Office of Procurement Service, Washington 25, D. C.

A SYMPOSIUM on "Trends of Thought in Chemical Education and the Postwar Era" will be held by the American Chemical Society in New York City on Tuesday, September 12. The symposium is part of the three-day program sponsored by the Division of Chemical Education. Dr. L. L. Quill, of the University of Kentucky, chairman of the division, will preside. It is announced that the rubber division of the society has cancelled its meeting because of wartime conditions.

THE National Metal Congress and War Conference Displays will be held at Cleveland during the week of October 16. Societies represented include the American Society for Metals, sponsor of the congress; the Iron and Steel and the Metals Divisions of the American Institute of Mining and Metallurgical Engineers; the American Welding Society; the Society for Experimental Stress Analysis, and the American Industrial Radium and X-Ray Society.

THE Upjohn Company, Kalamazoo, Mich., has made a grant of $5,900 for the continuation of studies on better methods for the production of penicillin started a year ago by the Industrial Science Research Institute of the Iowa State College. A similar grant was made by the same company at that time. Two other grants have been renewed—one of $4,000 from the Refrigeration Research Foundation, for research on the retention of nutritive properties of foods by refrigeration and on refrigerated storage of poultry, and one of $2,500 from the Poultry and Egg National Board for studies on the nutritive value of egg proteins. Studies on the analysis of gases will be continued also under a grant of $1,000 from Aeration Processes, Inc.

A RECOMMENDATION from the scientific director and the Scientific Advisory Committee of the Nutrition Foundation to publish a Latin-American edition of *Nutrition Reviews* was approved at a recent meeting of the executive committee.

THE Committee on Medical Research of the Office of Scientific Research and Development has announced the publication of a weekly journal entitled *Summary of Reports Received by the Committee on Medical Research*. The circulation is restricted to selected members of the Medical Corps in the United States, Canada and Great Britain. The journal is being edited and published under the direction of Dr. Kenneth B. Turner, assistant professor of medicine, who is on leave of absence from the College of Physicians and Surgeons of Columbia University.

THE Atlanta-Southern Dental School has been made a part of Emory University. This merger leaves only a few dental schools in the United States that are not integral parts of university groups. It is the aim of educational leaders of the dental profession to have all schools so associated.

DISCUSSION

FURTHER COMMENTS ON COMPARATIVE STUDIES IN HUMAN BIOLOGY

IN a recent note in SCIENCE[1] Professor Herskovits criticizes an article by Professor Dice which appeared in an earlier issue.[2] His criticisms concern primarily the loose usage of such terms as "psychological" and "race," but he also takes exception to certain implications which pertain to racial differences.

Although the author of the present note is in perfect accord with Professor Herskovits relative to the loose usage of terms, especially when they involve highly controversial issues, he is not so certain that he is in agreement with him relative to some of his statements which pertain to more important issues. Professor Herskovits is not very specific, but he leaves the impression that he is of the opinion that no physiological differences and no inherent response differences exist between major subdivisions of the human species. If primary human stocks (Mongoloid, Negroid and Caucasoid) and if subdivisions of these major groups ("races") have any validity at all, and the author believes that Professor Herskovits will admit that they do have some, it seems almost inevitable that both physiological and inherent response differences must exist. It is true that we do not have very much specific evidence for the latter kind of differences, but there is considerable evidence that many physiological differences exist. One could cite a long list of human variations which have a physiological basis and which have been shown to be inherited according to clearly defined laws. Many of these variations have been shown to be represented by different gene frequencies within different primary stocks and even within groups recognized as races.

[1] SCIENCE, n.s., 100: 50–51, 1944.
[2] *Ibid.*, n.s., 99: 457–461, 1944.

Perhaps Professor Herskovits's conception of a stock or racial difference is that it is an all-or-none affair. This need not be the case in order to be an important difference. Two stocks or races may be considered significantly different if they differ markedly with respect to the frequencies with which a variation occurs. In fact most of the anatomical differences which have been used by anthropologists for the differentiation of stocks and races are proportional differences rather than total ones. Certainly many of the characters used for the differentiation of accepted subdivisions of species among lower animals are not of the all-or-none kind.

What seems important to emphasize in this day and age is not that there are not stock and racial differences (even physiological and inherent psychological differences), for they will in all probability be found to be numerous, but that there is no reason for considering one racial group inherently superior or inferior to another. The racial dogma of inherent superiority of one racial group over another has no basis in fact.

Perhaps the author of the present note has misinterpreted Professor Herskovits. If so he is apologetic. He wishes only to see the question of racial differences weighed in the light of existing facts. It would be unfortunate if the current racial dogmas which have created so much trouble should cause the pendulum of opinion to swing unduly far in the other direction.

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INGESTED THIAMIN CHLORIDE AS A MOSQUITO REPELLENT[1]

THIAMIN chloride (vitamin B_1 hydrochloride) has been reported by Shannon[2] to relieve the itch of mosquito bites and to prevent further biting. A dose of 80 to 100 mgms on the first day and about 10 mgms per day thereafter was considered sufficient when taken by mouth. Military demands for a repellent taken orally justified further tests on this material at the Naval Medical Research Institute.

In preliminary experiments a subject ingested 505 mgms of thiamin chloride in three days. After taking 385 mgms he had a thiamin blood level of 6.9 gamma/100 cc. Mosquitoes (*Aedes aegypti*) were not repelled then or later when 505 mgms had been taken. In another test 100 mgms were ingested and the subject then exercised in an attempt to sweat the thiamin chloride to the surface of the skin. While the mosquitoes did not bite on his control arm (covered with indalone), his other arm was readily bitten.

In a second series of tests (Table 1), three subjects

TABLE 1

BITES PER MINUTE (SECOND SERIES OF TESTS)

Test subjects	1st day	2nd day	3rd day	Average
1	3.2	61.5	16.2	26.9
2	55.0	72.6	39.8	55.8
3	21.6	91.0	49.2	53.9
Controls				
1	88.4	96.0	...	92.2
2	76.0	63.2	39.8	39.7
3	96.0	...	59.8	77.9

ingested 120 mgms of thiamin chloride per day for three days (30 mgms four times daily). Repellency tests were started on the second day of treatment. Neither the rate of biting by the mosquitoes nor the subject's reactions to the bites differed materially from the controls.

These results have been confirmed by subsequent tests undertaken by the U. S. Department of Agriculture and the National Institute of Health.

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PRUNE DWARF AND THE CHERRY VIRUS COMPLEX

STUDIES begun in 1935 and carried on for approximately nine years on the cherry virus complex now indicate that several viruses are present in the sour cherry—yellows, ringspot, green-ring yellows, rosette and (?) mottle—and two in the sweet cherry—ringspot or tatter leaf and chlorotic spot or mottle. In addition, strains seem to exist in some of the viruses. For example, two strains of the cherry yellows virus are readily distinguishable based on the symptoms produced on peach seedlings.[1]

As the result of cross-inoculation studies repeated on three successive years it now appears that strain 1 of the sour cherry yellows virus and one strain of the sweet cherry chlorotic spot or mottle virus are in reality strains of the prune dwarf virus.

Comparative studies with prune dwarf virus, 10 different cultures of sour cherry yellows and ringspot viruses alone or mixed, and 2 different cultures of sweet cherry chlorotic spot virus on 12 different varieties or species of stone fruits (including sour

[1] The material in this article should be construed only as the personal opinion of the writers and not as representing the opinion of the U. S. Navy Department.

[2] W. Ray Shannon, "Thiamin Chloride—an Aid in the Solution of the Mosquito Problem," *Minnesota Med.*, 26: 799, 1943.

[1] E. M. Hildebrand, *Phytopath.*, 33: 6, 1943.

cherry (1), sweet cherry (3), peach (2), plum (3) and seedlings of Myrobalan plum (1), Mahaleb cherry (1) and peach (1), clearly indicate that the typical strain 1 of cherry yellows virus[2] which induces rosette and stunting of peach seedlings produces symptoms simulating prune dwarf[3] on Italian prune and Lombard plum. Also one strain of sweet cherry chlorotic spot virus invariably induces typical prune dwarf symptoms on Italian prune and Lombard plum. Chlorosis and stunting of Damson plum results from the cherry yellows strain but not from either the typical prune dwarf strain—obtained originally from masked Damson plum—or from the sweet cherry strain obtained from the Yellow Spanish variety.

On the basis of severity of symptoms on Italian prune the strains from Damson plum, sweet cherry and sour cherry fall in descending order. The same order also applies for the severity of rosette, stunting and necrotic symptoms on Rochester peach.

Indexing strain 1 of sour cherry yellows and the above sweet cherry strain on Montmorency cherry regularly induced typical cherry yellows symptoms within one year. Thus it may be concluded that three strains of prune dwarf virus exist identified with plum, sweet cherry and sour cherry. Detailed results will be published elsewhere.

E. M. HILDEBRAND

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ENZYMES IN DEHYDRATED VEGETABLES

ADEQUACY of blanching (scalding) of vegetables before dehydration is usually judged by absence or presence of positive peroxidase reaction in the dried products, except for cabbage in which catalase is used as the indicator.

In 1942, it was observed in tests for peroxidase made upon unblanched (raw) dehydrated cabbage, asparagus, carrots, peas, string beans, spinach and squash stored for six months at 30° C. and tested for peroxidase with dilute H_2O_2 plus dilute guaiacol or dilute benzidine, were devoid of positive peroxidase reaction. Dried raw potatoes, similarly stored, showed a faint positive peroxidase reaction.

A number of experiments have been made in the past two years in which various vegetables were dehydrated raw, and also after blanching five minutes at about 65.5° C. (150° F.), about 71° C. (160° F.), about 77° C. (170° F.), about 82° C. (180° F.) about 88° C. (190° F.), about 93° C. (200°F.) and 100° C. (212° F.). In one experiment, cabbage, potatoes, carrots, asparagus, string beans and squash so treated were stored one year and then tested. Of these only potatoes blanched at 65.5° C. showed any peroxidase activity, faint even in this case. All other samples were negative in reaction for peroxidase.

In other experiments, lightly blanched carrots and string beans (63° C. and 77° C.) became negative in peroxidase reaction in storage at 35° C. in less than 30 days; and peas in less than 90 days. Squash and potatoes showed slightly positive reactions even after 120 days' storage, but squash became negative by the end of ten months' storage. Dried potatoes, in another test, blanched at 77° C. (170° F.) and stored 18 months at 30° C. showed moderately positive peroxidase reaction. In this case and all other cases, however, the positive reaction in potatoes decreased markedly during storage.

Peas, blanched even at 100° C., showed positive "catalase" reaction (evolution of gas with dilute H_2O_2) after drying and during storage. This observation was confirmed by several individual experiments made on peas gathered at various seasons. The positive catalase reaction in other dried vegetables blanched below the death temperature of catalase decreased in intensity on storage and in some cases disappeared. Perhaps the reaction for peas is not that of a true catalase, but is due to some other catalyst.

The principal conclusion is that the positive peroxidase reaction in most inadequately blanched dehydrated vegetables rapidly decreases and finally disappears on storage; and decreases markedly in potatoes.

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Acknowledgment: Most of the experiments reported in this note were made possible by funds provided by the Office of the Quartermaster General of the U. S. Army. Some of the experiments were made by Mildred Smith, formerly of this division.

STARS IN AMERICAN MEN OF SCIENCE

IN the June 30 issue of SCIENCE, you published a letter from Mr. Stephen S. Visher, of Indiana University, concerning starred individuals in "American Men of Science." This has been of interest to me for many years. Outstanding individuals in specialized fields are not necessarily known to men in the main branches of science and are, therefore, apt to be overlooked when individuals are starred. For this reason, I favor the suggestion which was made to have a greater number of subdivisions and ask for the starring of a proportionate number of men under each subdivision. There might be a subdivision assigned to "Ceramics and Glass."

ALEXANDER SILVERMAN

THE UNIVERSITY OF PITTSBURGH

[2] E. M. Hildebrand, *Phytopath.*, 32: 712–719, 1942.
[3] E. M. Hildebrand, *Phytopath.*, 32: 741–751, 1942.

SCIENTIFIC BOOKS

DYNAMICAL ANALOGIES

Dynamical Analogies. By HARRY F. OLSON. New York: D. Van Nostrand Co., Inc. pp. xi + 196. 1943.

THERE was a time when the student of physics sought to understand electrical problems by seeking their dynamical analogies. To-day, the correct utilization of electrical methods, the wide potentialities of those methods and the enormous amount of energy which has been expended upon them, has resulted in a reversal of the process of thinking, so that the custom is now to transform dynamical problems to electrical problems as soon as possible, in order that the thinking and ingenuity of the investigator may be more readily exerted in that realm.

Dr. Harry F. Olson has done a distinct service to physicists and engineers in putting the story of this matter into a consistent and connected whole, and he performs no small service in collecting together in eight pages a list of that galaxy of new terms which the engineer has invented to the confusion of the physicist who, in contrast to the chemist and biologist, used to live in a heaven of simplicity as regards nomenclature. He can once more live in comfort in full knowledge of the fact that he knows where to find the meaning of "inertance," "rotational compliance" and a hundred other similar queer expressions.

Most of the discussions in the book are made in terms of comparisons of electrical, acoustical, rectilinear mechanical and rotational mechanical systems, and the foundation of the whole subject, as based upon the dynamical equations of Lagrange in the form contemplated in Maxwell's theories, is exhibited. It may be remarked that while the equations of Lagrange contain the conservation of energy, the converse is not true except in systems of one degree of freedom, and it is perhaps well that the student should clearly realize that conservation of energy is not in itself a sufficient criterion for the solution of problems, except in this case.

Matters are developed in as concise and simple a manner as is consistent with the range of problems studied. There is also a set of useful tables stating conventional symbols for and dimensions of important electrical, mechanical rectilinear, mechanical rotational and acoustical quantities.

Chapters I and II deal with definitions and an explanation of the meaning of the fundamental elements of electrical and mechanical discussions. The third chapter concerns electrical, mechanical rectilinear, mechanical rotational and acoustical systems of one degree of freedom. The fourth chapter extends the discussion to two and three degrees of freedom. Chapter V is devoted to corrective networks, Chapter VI to wave filters, Chapter VII to transients, Chapter VIII to driving systems, Chapter IX to generating systems, and there is a valuable chapter, No. X, dealing with such miscellaneous important theorems as Thevenin's theorems, superposition theorems, reciprocity theorems, etc. The last chapter is concerned with applications.

W. F. G. SWANN

BARTOL RESEARCH FOUNDATION OF THE FRANKLIN INSTITUTE,
SWARTHMORE, PA.

PROBLEMS IN CHEMISTRY

General Chemistry Problems. By W. M. SPICER, W. S. TAYLOR and J. D. CLARY. 120 pp. New York: John Wiley and Sons. 1943. $1.25.

IN this book the authors show in detail, with full explanations and many illustrative examples, how to solve most types of numerical problems encountered in the study of elementary chemistry. About 245 unsolved problems are included in the fourteen chapters, some with answers given, most without; and 118 "review problems" without answers are added, in groups with topic headings, at the end of the book.

The language used throughout is simple and understandable, the explanations logical and clear. The authors make an especial effort to induce the student to follow each thought-process involved in working a problem through to the end. They do not use nor advocate short-cuts even to the extent of setting up simple proportions. This full step-wise method, if followed patiently, leads to clear understanding of the principles involved; but at times becomes quite awkward and may distract attention from the central core of information used in solving the problem—as the balanced equation. One doesn't actually decide how many apples he can buy as described on page 32; nor does he, after the beginning phases, calculate the amount of zinc required to displace a given amount of hydrogen as described on the same page. However, this book is intended for use in the elementary stage where it is well to be meticulous.

Very useful features, to the average student, should be the chapter—six pages—devoted to an interesting discussion of "significant numbers"; a chapter on the use of exponential numbers, logarithms and the slide rule; and a chapter on using moles, gram-equivalents —chemical units in general—in solving problems where it is advantageous to do so. There are also frequent illustrations of rapid approximations as a check against gross errors.

On page 49 an error appears: "log of a quotient = log of the denominator—log of the numerator."

Such errors are few and otherwise negligible. On pages 81, 84 and 112 the student is asked to deal with physically impossible concentrations of calcium hydroxide and calcium sulfate; the problems are, however, workable on paper if not in the laboratory. The authors apparently prefer the pre-Debye-Hückel ideas of ionization, devoting three pages to the relation of freezing points to the extent of ionization of salts. Problems are given involving the solubility products of compounds of three and four ions without explanation in the text.

Such criticisms are, for the most part, of secondary importance, since the authors have clearly fulfilled their aims as set forth in an excellent introduction. This book should prove very satisfactory to the student who must learn to work problems alone, as well as for class or "quiz section" use.

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TEXT-BOOKS OF BOTANY

Textbook of Botany. By E. N. TRANSEAU, H. C. SAMPSON and L. H. TIFFANY. xi + 812 pp. 424 figs. New York: Harper & Brothers. 1940. $4.00.

WITH increasing emphasis, in both secondary schools and colleges, on survey courses in general science, frequently just skimming the crests of the waves—with the ever-present danger of merely lifting off the foam—it is consoling to come upon a volume that rides on a deep keel; and certainly this book does.

More than any other recent text, it surveys the whole field of botany; more than any other recent text, it stresses physiology and ecology. There are separate chapters, among the total of fifty-three, on "The Synthesis of Sugar," "Factors Influencing the Rate of Photosynthesis," "Synthesis of Starches," "Synthesis of Fats and Proteins," "Respiration," "Respiration and Plant Development," "Physical Processes Involved in the Movement of Materials in Plants," "Plant Behavior Related to Osmosis," "Transpiration," "Growth, Dormancy, and Germination of Seeds," etc. Similarly, from the ecological standpoint, individual chapters are devoted to "Seasonal Aspects of Plants," "Environment and Leaf Development," "Non-Green Plants," "Under-water Environments" and "The Vegetation of North America." The authors take ample cognizance of recent research in these fields. The illustrations are abundant, clear-cut, effectively reproduced, and many are original.

The evolutionary development of plants does not form the central theme of the second half of the volume, as in most of our texts. This makes it possible for the authors to draw on a wider range of material, and detracts somewhat from the unity of the book. However, it is in keeping with the pedagogical philosophy set forth in the preface. "We have tried to interfere as little as possible with the teacher who prefers to have students observe and discuss phenomena before books are consulted. Nearly every chapter has been written with the assumption that it will not be read by the student until the instructor thinks that the student's own observations should be supplemented by what is written." With more traditional methods of instruction, an eight hundred page volume to be mastered by beginning students would not be conducive to the preservation of undergraduate tranquility. In accordance with the philosophy that these authors have developed, however, a large treatise is a necessity. Those who disagree with this philosophy will prefer to use a shorter book; those who are converted will find this one well written, very inclusive, beautifully illustrated, modern and scientifically accurate.

Fundamentals of Plant Science. By M. ELLEN O'HANLON. xii + 488 pp. 268 figs. New York: F. S. Crofts & Co. 1941. $4.25.

INTENDED as a text-book for a full year's work in general college botany, "Fundamentals of Plant Science" amply does justice to its title. As in most of the standard texts, the first part is devoted to the cell and to the organs of the higher plants; part two, which comprises considerably more than half the volume, deals with the groups in the plant kingdom and with genetics, evolution and botanical history. There is a twenty-five page glossary at the end. The serious student will find much food for thought and very appreciable mental stimulation between these covers.

Any new text-book of general botany must win its spurs, and this one does have its distinctive features. The author is well known for her work on liverworts, and they are accorded effective if necessarily brief treatment. The Bryophyta are subdivided into the Hepaticae, the Musci and the Anthocerotales, thus raising this last group in rank, as suggested by Howe at the turn of the century. Similarly in the Pteridophyta, the lycopods are discussed first, where they really belong, and not last, as in most text-books. Fossil Pteridophyta, as well as fossil gymnosperms, are also given consideration. In view of the importance of the Psilophytales in phylogenetic interpretations, every adequate modern text-book must afford them consideration, and this one does. Similarly, the enterprising student may read and learn here of apogamy and apospory, the embryo sac of the lily and other atypical angiosperms, soilless growth of plants, tree rings, artificial parthenocarpy, hormones, xenia, the Gnetales and numerous topics which many other books fail to mention. The illustrations are largely original.

At the close of each chapter there are "Suggestions for Investigation and Discussion" and "References."

The references, perhaps more than any other characteristic of the book, are outstanding. The author has had the originality and the fortitude to add numerous recent citations, many from current periodicals, to her literature lists, so that students may travel farther afield and may also realize that plant science offers wide opportunities for investigation.

Every book reflects the personality of its author, and this is especially true of the present volume. It is written with verve and with feeling. At times it portrays the author's philosophy, and it may be preferred, because of this, in Catholic institutions. Scientifically it is a thoroughly sound and very creditable work.

The Plant World. By HARRY J. FULLER. xi + 592 pp. 306 figs. New York: Henry Holt and Company. 1941. $3.25.

"THE PLANT WORLD" is intended especially for students "registered in elementary botany courses principally because of the cultural and general educational value of the subject, rather than because of its usefulness as a prerequisite to a professional botanical career." As such, it fills a definite niche on the library shelf.

The book is divided into four parts. The first is a brief discussion of twenty-five pages dealing with such topics as the history of botany, the importance of the subject, the nature, "explanation" and origin of life, and the differences between animals and plants. In part two, which comprises considerably more than half the volume, the cell is considered, as are the structure and functions of roots, stems, leaves and flowers. The final chapter is devoted to variation, heredity and plant breeding. Then, in part three, the groups of the plant kingdom are rather briefly discussed. The last part is concerned with various aspects of evolution, and the final chapter is on ecology. The appendix contains "A Modern Classification of the Plant Kingdom," prepared by Dr. O. Tippo, and a glossary of some twenty pages.

If the students read and learn the material presented here, they will have a good understanding of the subject, for the author does not pull his punches, even though the book is addressed more specifically to nonprofessional students. All the main subjects usually considered in elementary courses are treated adequately, and the more general "cultural" topics, such as evolution, are emphasized. The style is simple, clear and direct. Modern research work is embodied in the discussions, and a definite attempt is made to show the importance to man of many topics such as wood, grafting, plant diseases, plant breeding, etc.

A large number of the illustrations are photographs and photomicrographs; they are well selected and clear, and most of them are new in text-book circles.

"The Plant World" is a readable digest of the thoughts of men who have been pondering this kingdom and of the human application of these thoughts.

Plant Biology. By PAUL WEATHERWAX. vi + 455 pp. 182 figs. Philadelphia: W. B. Saunders Company. 1942. $3.25.

THIS volume is intended for use in a short course in botany. It is cast largely in the traditional mold. The first part deals with the structure and functions of leaves, roots, stems and reproductive organs. Considerable emphasis is placed on physiology; there are separate chapters, among the total of twenty-seven, on "The Sources of Food," "The Utilization of Food," "Metabolism, Transport, and Food Storage," "Growth" and "Responses to Stimuli." There is a clear chapter on "Heredity."

Somewhat less than half the book is devoted to the groups in the plant kingdom. This treatment is more adequate than that in many larger texts. The author finds opportunity to discuss and illustrate such plants as *Marsilea, Salvinia, Azolla, Isoetes, Psilotum, Lepidodendron, Ginkgo, Ephedra* and *Welwitschia.* Individual chapters toward the end of the volume are devoted to "Evolution," "Pollination," "Dormancy and Dispersal" and "Migration, Communities, Succession." There is a twenty-five page glossary. With very few exceptions, the illustrations are from the pen or the lens of the author, and they are clearly and carefully prepared.

"Plant Biology" is a sound book, substantial in its contents, direct in its style. It is the work of a mature scientist who has the ability to present to students the botanical heritage of the past set in the focused light of the present.

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SPECIAL ARTICLES

DENSITY AND SIZE OF INFLUENZA VIRUS A (PR8 STRAIN) IN SOLUTION[1]

INFORMATION regarding the density and the size of virus particles in solution can be obtained from measurements of rate of sedimentation of the particles

[1] This investigation was supported through the Commission on Influenza, Board for the Investigation and Control of Influenza and Other Epidemic Diseases in the Army, Preventive Medicine Service, Office of the Surgeon General, United States Army, and in part by a grant to Duke University from the Lederle Laboratories, Inc., Pearl River, N. Y.

through media of different densities. Measurements of this sort have been made on the elementary bodies of vaccinia[2, 3, 4, 5] and on influenza virus A (WS strain)[4] with solutions of materials such as sodium chloride, sucrose, urea and glycerol. Under these conditions, however, the rate of sedimentation of the viruses in the concentrated solutions changes rapidly and appreciably with time, due probably to change in virus particle size and density in the solutions of high osmotic pressure. Because of this, the values obtained for particle density have been considered to be greater than the true values and those of the calculated particle sizes correspondingly too small. A possible means for obviating this difficulty would be the use of solutions of a material of high molecular weight and thus of low osmotic pressure in the range of density desirable for study. In the present work use has been made of solutions of bovine albumin for studies on the density in solution of the influenza virus A (PR8 strain).

The virus was obtained in purified preparations from virus-infected chorio-allantoic fluid of chick embryos[6, 7] and dispersed in appropriate concentration in Ringer-$CaCl_2$ solution.[6] The bovine albumin was a solution of a crystalline fraction which Dr. Hans Neurath obtained from the Armour Laboratories, Chicago, Illinois, through the courtesy of Drs. E. J. Cohn and H. B. Vickery, Harvard Medical School. The albumin was added to the virus preparation, and sedimentation rates of the virus were then measured in the air-driven ultracentrifuge employing the Lamm scale optical system.

The effects of bovine albumin in solution on the sedimentation rate of the virus with respect to the time of exposure are shown in Fig. 1. The concentration of albumin was 12.5 per cent. and of the virus 2.0 mg per ml. The sedimentation rate of the virus in this system was measured at intervals over a period of 28 hours, during which the preparation was kept in a tube immersed in crushed ice. In Fig. 1, where the observed sedimentation rates ($S_{25°}$) have been multiplied by the absolute viscosity ($\eta_{25°}$)[8] of the albumin solution, it is seen that no significant change was observed in the sedimentation rate over a period of 2.5 hours. Subsequently a small increase (4 per cent.) was seen, and this vanished in 28 hours. For comparison, the effects of sucrose in 11 per cent. concentration, which contained the same salts and was of about the same density as that of the albumin solution, are shown also in Fig. 1. In sucrose the sedimentation rate of the virus increased rapidly from the start to attain

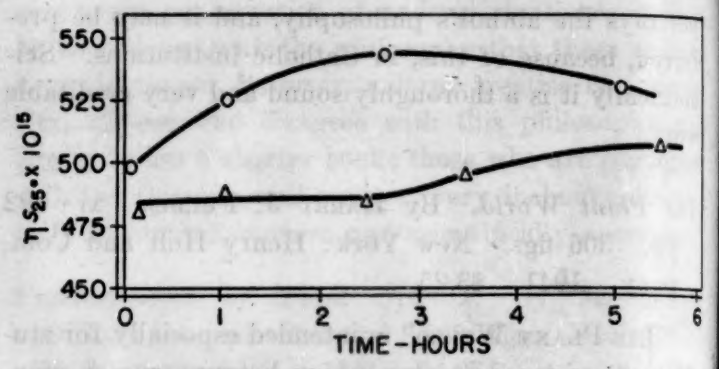

FIG. 1. Dependence of sedimentation rate of influenza virus A (PR8 strain) on time of contact with 12.5 per cent. bovine albumin solution (triangles) and with 11 per cent. sucrose solution (circles). η = absolute viscosity of suspending medium, *i.e.*, albumin or sucrose solution at 25° C. and $S_{25°}$ = observed sedimentation rate of the virus at 25° C.

in 2.5 hours a level approximately 10 per cent. greater than the value observed after the shortest interval of exposure compatible with the method of study.

With this evidence of lack of effect of bovine albumin solutions on the density and size of the influenza virus particles, a series of sedimentation measurements were made on solutions of the same virus and salt content but of albumin content varying from 0 to 25 per cent. Each study was made immediately after addition of the albumin to the virus preparation. In Fig. 2 the observed sedimentation rates, corrected as before for viscosity, are plotted in relation to the density of the albumin solution. The observed points (triangles) indicate that the relationship is linear. Similar results of another experiment with a different preparation of the influenza virus A are shown in the circles of Fig. 2. The line of Fig. 2 was drawn through the points of the two experiments by the method of least squares. Assuming that the relationship is linear throughout its course, the extrapolated line intercepts the abscissa to indicate a limiting density of the solvent medium of 1.104.

Electron micrographs have shown the influenza

[2] W. G. MacCallum and E. H. Oppenheimer, *Jour. Am. Med. Asn.*, 78: 410–411, 1922.

[3] H. Bechhold and M. Schlesinger, *Biochem. Zeit.*, 236: 387–414, 1931.

[4] W. J. Elford and C. H. Andrewes, *Brit. Jour. Exp. Path.*, 17: 422–430, 1936.

[5] J. E. Smadel, E. G. Pickels and T. Shedlovsky, *Jour. Exp. Med.*, 68: 607-627, 1938.

[6] A. R. Taylor, D. G. Sharp, D. Beard, J. W. Beard, J. H. Dingle and A. E. Feller, *Jour. Immunol*, 47: 261–282, 1943

[7] A. R. Taylor, *Jour. Biol. Chem.*, 153: 675–686, 1944.

[8] The viscosity measurements were very kindly made by Dr. John O. Erickson.

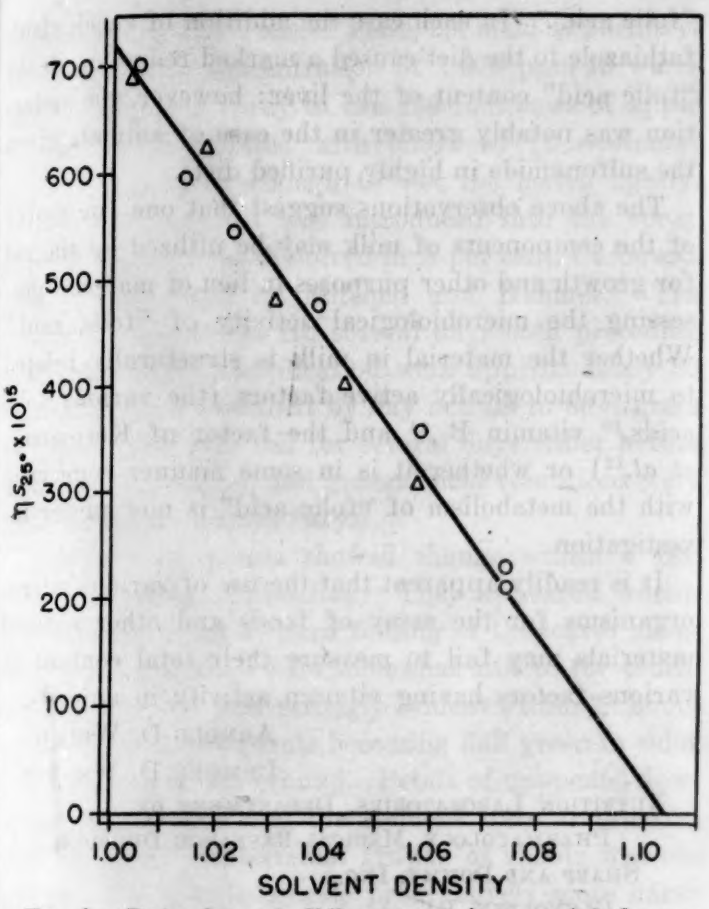

FIG. 2. Data from 2 different specimens of influenza virus A (PR8 strain) (triangles and circles, respectively) showing the linear dependence of $\eta S_{25°}$ on solvent density as the latter is varied with bovine albumin in concentrations of 0 to 25 per cent. The value of the density at the intercept at the base is 1.104.

virus A (PR8 strain) to consist of rounded or ovoid particles[6] which would be expected to sediment as spheres subject to retardation according to Stokes's law. The particle radius "r" can then be derived from the particle density ($\rho = 1.104$ from the intercept of the line of Fig. 2) and the sedimentation constant, $S_{20°}$, at infinite virus dilution.[9]

$$\tfrac{4}{3}\pi r^3(\rho_v - \rho_s)\,\omega^2\,R = 6\pi\eta r\frac{dR}{dt} \qquad (1)$$

where ρ_s = solvent density, ω = angular velocity, and R = distance from the particle to the axis of rotation. Inasmuch as $S = \frac{dR}{dt}\frac{1}{\omega^2 R}$, equation (1) for particle radius in solution then becomes

$$r = \sqrt{\frac{9}{2}\frac{\eta_{20°}\,S_{20°}}{(\rho_v - \rho_s)}} \qquad (2)$$

where the viscosity of water at 20° C. is $\eta_{20°}$. For influenza virus A (PR8 strain) $S_{20°} = 742 \times 10^{-13}$ [9], which gives for the radius of the sedimenting particle the value 57.7 m μ.

In previous reports[6, 9] of estimates of the particle size of influenza virus A (PR8 strain) from sedimentation data, the density value employed in the absence of other data was the reciprocal of the partial specific volume ($\frac{1}{v}$) of the dry virus determined in the pyknometer. The diameter found in this way was 80 m μ. The density of the virus particle measured in solution in the present work, 1.104, was much smaller than $\frac{1}{v}$, 1.215, and the average diameter of the particle calculated with the present value was 115 m μ. This diameter is slightly larger, as might be expected, than that recently reported, 101 m μ, from electron micrographs[9] after direct calibration of the electron microscope by a method other than standardization on the basis of the width of tobacco mosaic rods.

It would appear that the procedures employed here provide a relatively simple method for the direct determination of the density of virus particles in solution. Further, the difference in the density of the dry virus and that of the virus in solution gives an estimate of the quantity of water associated with the particle of influenza virus A, namely, about 66 per cent. by volume. It is of interest to note that this amount of water is greatly in excess of that considered to be associated with protein molecules as water of hydration but is similar to the quantity found in organisms of complicated biological structure.

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THE POSSIBLE EXISTENCE OF A MICROBIOLOGICALLY INACTIVE "FOLIC ACID"-LIKE MATERIAL POSSESSING VITAMIN ACTIVITY IN THE RAT

IT is well established that certain nutritional deficiencies can be produced in the rat by incorporating various sulfonamides in otherwise adequate highly purified diets.[1, 2, 3] The depression of growth rate and the development of pantothenic acid deficiency, which are seen under these circumstances, can be effectively counteracted by dosage with crystalline biotin and con-

[9] D. G. Sharp, A. R. Taylor, I. W. McLean, Jr., D. Beard and J. W. Beard. To be published.

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[1] S. Black, J. M. McKibbin and C. A. Elvehjem, *Proc. Soc. Exp. Biol. and Med.*, 47: 308, 1941.

[2] A. D. Welch, *Fed. Proceedings*, 1: 171, 1942.

[3] F. S. Daft, L. L. Ashburn and W. H. Sebrell, SCIENCE, 96: 321, 1942.

centrates containing "folic acid."[4, 5, 6, 7] Severe leucopenia and granulocytopenia, similarly produced, have been cured promptly by the administration of very small doses of a crystalline folic acid or of vitamin B_c.[8]

The exceedingly low content of "folic acid" in milk[9] suggested that suitable reinforcement of its content of vitamins and minerals and its supplementation with a poorly absorbed sulfonamide should provide a simple diet for the production of "folic acid" deficiency. Accordingly, powdered whole milk (Klim) was fortified as follows (per 100 grams): $FeSO_4 \cdot 7H_2O$, 25 mg; $CuSO_4 \cdot 5H_2O$, 7.8 mg; thiamine chloride, 0.8 mg; riboflavin, 1.6 mg; pyridoxine hydrochloride, 0.8 mg; nicotinic acid, 4.0 mg; calcium pantothenate, 4.4 mg; choline chloride, 100 mg; and a source of vitamins A, D and E, 100 mg [corn oil, 82 mg; A and D concentrate, 14 mg (6300 units A and 1250 units D); alpha-tocopherol, 4 mg]. Assays with *Lactobacillus casei* ε have shown that such a diet contains from 0.7 to 1.8 μg of "folic acid" per 100 gm; typical highly purified diets have contained from 0.5 to 1.4 μg of "folic acid" per 100 gm; assays with *Streptococcus lactis R* have given similar results.

The inclusion of succinylsulfathiazole in the dried milk diet, in amounts as large as 10 per cent., in contrast to the effects produced by levels of only 1 or 2 per cent. in highly purified diets, caused no evidence of nutritional deficiency in rats during a period of 14 weeks following weaning. The growth rate of the animals given the milk-sulfonamide ration was not inferior to that of animals on the milk ration alone, and leucopenia did not develop. At the end of the period of feeding, total leucocyte counts of 5,000 to 22,000 were observed, while on the milk diet alone the counts ranged from 7,000 to 13,000.

Assays for "folic acid" in the tissues of these and other rats showed that considerably larger amounts of microbiologically active material were present in the hepatic tissue of animals fed a whole milk ration than were found in the liver of rats given a highly purified diet "contaminated" with a comparable amount of "folic acid." In each case the addition of succinylsulfathiazole to the diet caused a marked reduction in the "folic acid" content of the liver; however, the reduction was notably greater in the case of animals given the sulfonamide in highly purified diets.

The above observations suggest that one (or more) of the components of milk may be utilized by the rat for growth and other purposes in lieu of material possessing the microbiological activity of "folic acid." Whether the material in milk is structurally related to microbiologically active factors (the various folic acids,[10] vitamin B_c,[11] and the factor of Keresztesy, *et al.*[12]) or whether it is in some manner concerned with the metabolism of "folic acid" is now under investigation.

It is readily apparent that the use of various microorganisms for the assay of foods and other natural materials may fail to measure their total content of various factors having vitamin activity in animals.

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THE HERBICIDAL ACTION OF 2,4 DICHLOROPHENOXYACETIC AND 2,4,5 TRICHLOROPHENOXYACETIC ACID ON BINDWEED[1]

THE use of growth-regulating substances on plants has been directed mostly towards improving their performance in terms of usefulness, such as increasing the set of fruit, preventing the premature dropping of fruit, speeding the rootings of cuttings and developing fruits which are seedless. It is well known, however, that growth substances may be toxic to plants in concentrations greater than those used to secure these desirable responses.

Kraus,[2] and more recently Mitchell and Hamner,[3] have suggested the possibility of growth-regulating substances as selective herbicides, since species and varieties of plants show wide differences in the degree to which they react or respond to the various compounds. Some of the more potent of these compounds are the substituted phenoxy compounds.[4]

[4] Folic acid, as defined (H. K. Mitchell, E. E. Snell and R. J. Williams, *Jour. Am. Chem. Soc.*, 63: 2284, 1941) refers to a factor essential for the growth of *Streptococcus lactis R*. Since there appear to be several entities with activity for that organism, we have used the term folic acid to include factors with microbiological activity for *L. casei* ε, as well as *Strep. lactis R*.

[5] L. D. Wright and A. D. Welch, SCIENCE, 97: 426, 1943.

[6] H. D. West, N. C. Jefferson and R. E. Rivera, *Jour. Nutr.*, 25: 471, 1943.

[7] L. D. Wright and A. D. Welch, *Jour. Nutr.*, 27: 55, 1944.

[8] F. S. Daft and W. H. Sebrell, U. S. Pub. Health Repts., 58: 1542, 1943.

[9] R. J. Williams, V. H. Cheldelin and H. K. Mitchell, The Univ. of Texas Publication No. 4237: 97, 1942.

[10] B. L. Hutchings, E. L. R. Stokstad, N. Bohonos and N. H. Slobodkin, SCIENCE, 99: 371, 1944.

[11] J. J. Pfiffner, S. B. Binkley, E. S. Bloom, R. A. Brown, O. D. Bird, A. D. Emmett, A. G. Hogan and B. L. O'Dell, SCIENCE, 97: 404, 1943.

[12] J. C. Keresztesy, E. L. Rickes and J. L. Stokes, SCIENCE, 97: 465, 1943.

[1] Journal Paper No. 596 of the New York State Agricultural Experiment Station, Cornell University.

[2] E. J. Kraus, correspondence, August, 1941.

[3] J. W. Mitchell and C. L. Hamner, *Bot. Gaz.*, 105: 474–483, 1944.

[4] P. W. Zimmerman and A. E. Hitchcock, Contrib. Boyce-Thompson Institute, 12: 321–343, 1942.

On July 14, 1944, one of these, 2,4 dichlorophenoxyacetic acid at a concentration of 1,000 ppm in water was applied as a spray to two 100-foot rows of apple nursery stock infested with bindweed (*Convolvulus arvensis L.*)—just enough to wet the leaves lightly. Before the chemical was introduced into the spray tank of water it was dissolved in .5 per cent. Carbowax 1500 as described by Mitchell and Hamner.[3] The diurnal temperatures for several days both preceding and following the application were approximately 80 to 85 degrees Fahrenheit by day and 55 to 60 degrees by night. No rain fell for several days either before or after application, and general field conditions were what would be termed "dry."

The sprayed plants showed change within a few hours following application. They appeared wilted. There was a slight upward folding of the leaves along the midrib and they were somewhat stiff to the touch. These symptoms were strongly evident within 24 hours of application, the plants becoming dull green in color and lying flat to the ground. Petals of unopened flowers failed to open and the stamens were arrested in development. No terminal growth of shoots was observed. The plants became progressively more harsh and woody to the touch during succeeding days. By the fifth day following application of the spray, the basal leaves were yellow, and at ten days the above-ground parts were dry and dead.

The etiolated, below-ground parts five days after spraying were spongy, water-soaked and enlarged to twice the diameter of similar parts of unsprayed plants. The outer layers showed longitudinal splitting and sloughing off.

Buds, which typically arise from the underground stems of the plant and which are responsible in large part for the difficulty of its eradication and for its noxiousness as a weed, were checked and failed to develop as shoots. Many small roundish budlike swellings appeared at nodes and rubbed off easily.

Sections of treated and untreated roots and underground stems were placed in a propagation frame in order to study bud development. Shoots arose from underground roots and stems of untreated plants, but not from treated plants. Within five days of placing in the frame, the roots and underground stems from treated plants were entirely dead.

On July 24, a second series of applications prepared in the same way with Carbowax were made to three 600-foot rows at concentrations of 1,000 ppm, 500 ppm and 100 ppm. Day temperatures were 80 to 85 degrees Fahrenheit; a rainy period immediately preceded application. The concentrations of 1,000 ppm and 500 ppm were equally effective and plant response was similar to that from the previous treatment at 1,000 ppm made on July 14. The concentration of 100 ppm also produced a definite response but of reduced intensity. A third set of applications at 1,000 ppm, 500 ppm and 100 ppm, followed within 15 minutes by a rain, were also of reduced intensity.

Miscellaneous applications of 2,4 dichlorophenoxyacetic acid at 1,000 ppm to Canada thistle, dewberry, broad-leaf plantain, dandelion, red raspberry, wild carrot, poison ivy, burdock, milkweed, sorrel and wild lettuce resulted in varying responses, such as severe curvature and chlorosis.

Preliminary observations on treatments with 2,4,5 trichlorophenoxyacetic acid indicate that this material also may be effective as an herbicide. Development of growing points of bindweed were not only arrested but also browned and killed at concentrations of 1,000 ppm, 500 ppm and 100 ppm, prepared with Carbowax 1500.

The method of killing by the use of growth-regulating substances seems of special significance with such a plant as bindweed which is deeply rooted and which regenerates so readily not only from seed but also from shoots arising from underground stems and roots. Not only is the foliage destroyed but also portions of the plant are affected at some distance from the point of application. It is possible that the effectiveness of the materials may be increased by applying them in warm solutions or as aerosols.[5]

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[5] C. L. Hamner, H. A. Schomer and L. D. Goodhue, SCIENCE, 99: 85, January 28, 1944.

[3] F. M. Burnet, *Jour. Path. Bact.*, 37: 107, 1933.

[3] F. M. Burnet and D. D. Faris, *Jour. Bact.*, 44: 241, 1942.

[4] Examined through the courtesy of Simeon Trenner.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A MODIFIED TECHNIC OF CUTTING THE EGG SHELL FOR VIRUS CULTURE

THE culture of virus on the chorio-allantoic membrane of the developing chick embryo according to the method of Woodruff and Goodpasture,[1] as well as the modifications by Burnet[2] and Burnet and Faris,[3] requires that the egg shell be cut. This procedure is accomplished by the use of a small electrically operated rotary drill or the small vibrating cutter,[4] which recently appeared on the market. The latter instrument, which makes 120 vertical strokes per second, has

[1] A. M. Woodruff and E. W. Goodpasture, *Am. Jour. Path.*, 7: 209, 1931.

the advantage of not damaging the egg membrane, as may occasionally happen with the rotary drill.

It is customary to hold the egg to be cut in one hand and the drill in the other. This method of handling is a source of difficulty. A drill, when used by one operator for any length of time, may provoke one or all of the following complaints: (1) uncomfortable warmth because of the heat generated by the motor and by friction, (2) the bulk of certain drills makes them awkward for those with small hands, (3) the weight of the instrument becomes tiresome, (4) muscles become cramped from gripping the drill tightly, and (5) shell fragments and dust get in the face and eyes of a right-handed person since the drills rotate in a counter-clockwise direction. These complaints are voiced as readily by those using the professional dental drill with a flexible shaft as by those using the small, compact, hand-sized motor drills or vibrating tool.

These factors we have eliminated by clamping the drill to a stand so that the person engaged in the work need hold only the egg. At the present time drills can not be purchased readily and repairs are not always possible; therefore, we have begun using the electric stirrers available in this laboratory.

An electric stirring motor, preferably one fitted with a rheostat, is clamped on a stand with the drive shaft in a horizontal or slightly tilted position at a height convenient for the operator. This height will generally be about 5 inches above the base of the stand. The drive shaft is pointed towards the operator's right so that the shell fragments and dust will be directed away from the operator. The usual mandrel and grinding stone are attached to the stirrer. The addition of a chuck or wrapping of adhesive tape to the mandrel may be necessary for its secure fastening. Care should be taken to center the mandrel so that the stone rotates without describing an arc in addition to its prescribed movement. Support for the hands is obtained by allowing them to rest on the table or base of the stand.

Skill in cutting the shell in this manner is acquired rapidly and the average person can prepare more eggs in a shorter length of time than is possible when both the egg and the drill are held in the hands. Women engaged in this work have welcomed the method.

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THE PREPARATION OF APOZYMASE FROM BAKER'S YEAST

THE determination of coenzyme I, according to the methods of von Euler[1] and Myrbäck,[2] later modified by Axelrod and Elvehjem,[3] depends upon the principle that the addition of coenzyme I to a washed yeast preparation (apozymase) will result in fermentation, the rate of which is proportional to the amount of coenzyme I added. The above workers have used brewer's yeast for the preparation of apozymase, as has Greig[4] in her simplified method of preparation.

We have recently been able to prepare an apozymase from baker's yeast (Fleischmann's) which is usually more easily obtained than is fresh brewer's yeast. It is prepared as follows:

To 1.5 liters of distilled water in a large beaker are added 100 gm fresh baker's yeast and 25 cc carbon tetrachloride. This mixture is stirred with a power stirrer for one hour, centrifuged, the supernatant discarded and the yeast dried overnight under a fan. When the yeast is thoroughly dry, it is resuspended in 2 liters distilled water and stirred for three hours. The mixture is again centrifuged, the supernatant discarded and the yeast dried under a fan. When dry the yeast is ground and stored in a desiccator.

The dry powder is stable at least a month. It may be added to the reaction vessel as a powder, or is easily suspended in water or phosphate buffer for pipetting.

Since this yeast is quite aerobic, oxygen uptake is still demonstrable after this method of preparation, and consequently the coenzyme I determination must be carried out in an atmosphere of nitrogen. With most preparations there is a latent period of one hour from the time at which the apozymase is introduced into the vessels until active fermentation begins. We have found that 100 mg of this preparation per vessel gives a CO_2 evolution of about 200 mm^3 per hour in the presence of 20 micrograms of coenzyme I.

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